REMARKS

Claims 16–27 are pending in the present Application. Claims 16 and 18 have been amended to clarify the antecedent basis for the term monomer(s), and that the monomer can be either a lactide or a glycolide monomer, or a combination of lactide and glycolide monomers. New claim 33 has been added to specify that the catalyst system is free of metallic catalyst. Applicant respectfully requests reconsideration of the Application in light of these amendments and the following remarks.

Obviousness

The Office Action rejects claims 16 and 18–27 as being unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 6,355,772 ("Gruber") in view of U.S. Patent No. 3,047,524 ("Bowman").

Claim 16 recites, among other limitations, a catalytic system comprising a strongly acidic ion-exchange resin polymeric **catalyst** and a **(co)oligomerization additive** of the general formula (2) for the (co)oligomerization of one ore more lactide and/or glycolide monomer(s) by ring opening polymerization. The claim also requires that the **quantity of lactide and/or glycolide monomer(s) relative to the quantity of (co)oligomerization additive ranges from 2 to 30 molar equivalents**. As noted in the specification, metal catalyst systems known for ring opening polymerization of lactide and/or glycolide usually lead to contamination of the polymer. The present invention allows for the reproducible, high yield, and controlled polymerization of lactide and glycolide without the use of a metallic catalyst.

Gruber discloses a melt-stabilized lactide polymer nonwoven fabric prepared by ring opening polymerization of lactide. The poly(lactide) polymer chains have a "number average molecular weight of from about 10,000 to 300,000." (Gruber, col. 5, ll. 21–23.) Gruber lists a number of catalysts that "have been cited in the literature for use in the ring opening polymerization of lactones." (Gruber, col. 12, ll. 63 to col. 13, ll. 13.) These catalysts are all metal catalysts and include, for example, tin(II) bis(2-ethyl hexanoate) also known as Fascat 2003. In Example 8, Gruber explores the feasibility of using a solid supported catalyst, and uses two solid catalysts: tin (II) oxide and Amberlyst 36 resin beads, to polymerize lactide. (Gruber, col. 13, ll. 59–65.) The tin (II) oxide catalyst resulted in a polymer having a Mn of 77,228, while the Amberlyst 36 resin resulted in a polymer having a Mn of 1,112. While the metal containing catalyst produced a polymer having a "number average molecular weight of from about 10,000

to 300,000," the Amberlyst 36 resin produced a much lower molecular weight polymer. Gruber makes no other mention of the Amberlyst 36 resin.

The Office Action points to Gruber's mention of a "molecular weight control agent" that is added to the polymerization reaction. Gruber states that the molecular weight control agents "include active hydrogen bearing compounds, such as lactic acid, esters of lactic acid, alcohols, amines, glycols, diols and triols which function as chain initiating agents." (Gruber, col. 15, ll. 8–12.) Gruber also states that "[s]uch molecular weight control agents are added ***in sufficient quantity*** to control the number average molecular weight of the poly(lactide) to between about 10,000 and about 300,000." (Gruber, col. 15, ll. 12–15.) Gruber discloses using lactic acid as a "molecular weight control agent" in a number of the examples involving metal catalytic ring opening systems to target a specific molecular weight.[1] No molecular weight control agent was utilized in the Amberlyst 36 embodiment of Example 8. Indeed, the fact that Gruber uses the molecular weight control agent to target molecular weights between about 10,000 and 300,000, combined with the fact that the polymer produced by the Amberlyst 36 example had a Mn of 1,112, suggests that a molecular weight control agent was not used in the Amberlyst 36 example. Finally, as the molecular weight control agent actually lowers molecular weight by increasing polymer chain initiation,[2] and the molecular weight of the resultant polymer in the Amberlyst 36 example is already below the target range, there would have been no reason to use the molecular weight control agent in the Amberlyst 36 example of Gruber.

The Amberlyst 36 example states that "[t]he resin was prepared by rinsing 2 times with 10 volumes dry methanol, then dried for several hours under high vacuum for several hours at 40°C." The Amberlyst 36 example is silent as to the use of alcohol during the reaction. Nor does the example mention the use of a molecular weight control agent. To the extent that the Office

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[1] *See* Example 11 ("Molecular weight was controlled by adding a small quantity of lactic acid, the target molecular weight was 80,000 Mn."); Example 12 ("Lactic acid was added as a molecular weight control agent to target a number average molecular weight of 50,000."); Example 13, test 3 ("Lactic acid was added to control molecular weight to about 75,000 at full conversion"); Example 13, test 5 ("Lactic acid was added to control number average molecular weight to an estimated 80,000 at full conversion."); Example 13, test 7 ("Lactic acid was added to target the molecular weight to an Mn of 80,000.")

[2] Gruber states that experimental results suggest "that each lactic acid molecule initiates about one polymer chain, regardless of temperature." (Gruber, col. 26, ll. 23-25.)

Action is relying on the methanol rinsing disclosure to meet the claimed "(co)oligomerization additive" limitation, Applicant notes that the amount of methanol in the resin left over from the rinsing step does not meet the claimed requirement that the "additive ranges from 2 to 30 molar equivalents." Gruber fails to expressly disclose or suggest adding "from 2 to 30 molar equivalents" of methanol to the reaction mixture. Moreover, there is no indication that Gruber inherently discloses this limitation. "To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.'" *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950–51 (Fed. Cir. 1999). The Office Action fails to show how the claimed amount of "(co)oligomerization additive" is expressly or inherently present in the Amberlyst 36 example of Gruber.

Although Gruber teaches rinsing the resin with methanol, the amount of methanol present at the time of the reaction would be much lower than the required "2 to 30 molar equivalents" as Gruber expressly teaches that after rinsing, the resin is then "dried for several hours under high vacuum for several hours at 40°C." The boiling temperature of methanol under atmospheric pressure is 65.6°C. As the pressure is lowered to 10 mm Hg, the boiling point drops to -10°C. (Exhibit A) Under vacuum pump conditions, the boiling temperature would be even less than -10°C. It is fair to say that Gruber discloses a methanol rinse followed by removal of all but perhaps trace methanol from the resin. The claims on the other hand require a ratio of monomer to additive from "2 to 30 molar equivalents." Example 8 of Gruber utilizes 30 grams of monomer (24 g L-lactide and 6 g of D,L-lactide), which is equal to 0.21 mols of lactide (144 g/mol). The claimed ratio, R, is equal to $n_{lactide}/n_{MeOH}$, the number of moles of methanol is $n_{lactide}/R$, and this would range from 0.21/30 to 0.21/2, or 0.007 to 0.105 moles of methanol. The molar mass of methanol is 32 g/mol. Thus, the claims would require 0.007*32 to 0.105*32, or 0.224 to 3.36 grams of methanol. The density of methanol is 0.79 g/ml at 25°C. Accordingly, the volume of methanol required to meet the claims would be 0.224/0.79 to 3.36/0.79, which is ***0.28 ml to 4.25 ml*** methanol. In the case of methanol, the claims require a volume that far exceeds any trace levels of methanol that may be left over after drying for several hours under a high vacuum at 40°C. Moreover, Gruber's teaching that the methanol should be removed by drying at 40°C for

several hours is a teaching away from supplying a (co)oligomerization additive within at the ratio required by the claims.

Bowman fails to cure the deficiencies of Gruber. Bowman discloses an organic polymeric material suitable for manufacturing plastic explosives. The reaction used by Bowman is a glycolic acid polycondensation reaction that uses glycolic acid as a monomer and does not involve a catalyst. This reaction differs from the claimed ring opening catalytic polymerization reaction. Further, Bowman does not disclose lactide and/or glycolide monomer(s), much less that the "quantity of lactide and/or glycolide monomer(s) relative to the quantity of (co)oligomerization additive ranges from 2 to 30 molar equivalents" as claimed. As Bowman discloses adding alcohol after the reaction has completed or toward the end of the reaction "to more completely stabilize the polymer characteristics," it is clear that the alcohol plays no role in the polymerization reaction. Bowman, col. 2, ll. 15–16. Moreover, while the Office Action now states that the "alcohol . . . can be considered as part of a catalytic system," there is no catalyst system disclosed in Bowman. In fact, the extent of polymerization in Bowman is controlled by other factors that drive the rate of polymerization, namely by increasing temperature and reducing reaction pressure to remove water from the reaction. *See* Bowman, column 1, lines 56–62. The reaction is stopped when the polymer product achieves the desired melting point. *See id.* Applicant respectfully submits that Bowman fails to teach or suggest the addition of alcohol during the (co)oligomerization of lactide and glycolide. Further, a person of ordinary skill in the art would not have looked to Bowman's glycolic acid polycondensation reaction when considering catalytic systems for ring opening polymerization of lactide and/or glycolide. Finally, Gruber teaches away from adding an alcohol to the Amberlyst resin catalyzed reaction system by drying the resin for several hours under high vacuum at 40°C after washing with methanol. Accordingly, the rejection of claim 16 under 35 U.S.C. § 103(a) is improper and must be withdrawn.

Claims 18–27 are dependent on claim 16, which, as amended, has been shown to be patentable over Gruber and Gruber in view of Bowman. Applicant respectfully submits that claims 18–27, by virtue of their dependency from claim 16, are also patentable for the same reasons claim 16 is patentable. Accordingly, Applicant requests withdrawal of the rejection of claims 18–27 as being unpatentable under 35 U.S.C. § 103(a) over Gruber in view of Bowman.

CONCLUSION

For at least the reasons set forth above, Applicant respectfully submits that claims 16 and 18–27 are in condition for allowance. Should the Examiner believe anything further is needed to place the application in condition for allowance, the Examiner is invited to contact Jeff B. Vockrodt at (202) 419-2021.

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Respectfully Submitted

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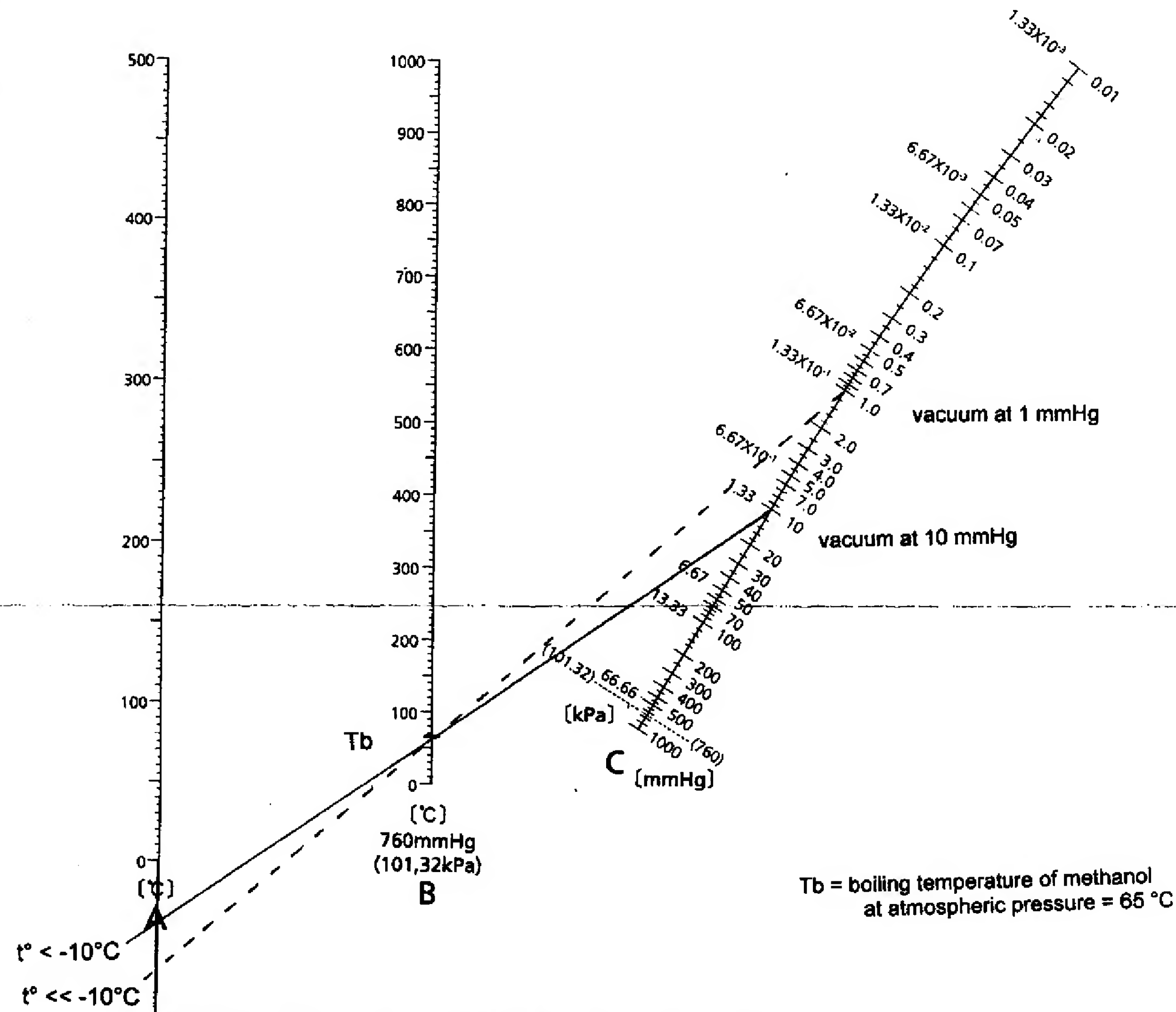
EXHIBIT A

Pressure-Temperature Nomograph



● How to calculate the bp under atmospheric pressure from bp under reduced pressure

① Connect a degree on the line C and its corresponding bp on the line A under reduced pressure using a straight line.

② An intersection found by step ① on the line B serves as an approximate bp in atmospheric pressure.

*This nomograph applies to nonassociated solvent.
Since the bp obtained from this nomograph is an approximate value, it is not an exact bp.

出典:Science of Petroleum. Vol.II. p.1281 (1938).

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